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Nutritional and Environmental Conditions for the Growth of *Coriolus versicolor*, a Wood Decaying and Medical Fungus[1]

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Abstract *Coriolus versicolor* is a wood decaying fungus, it also has been used as a medicine in chinese tradition to cure many chronic diseases. However, it is also a harmful fungus on the logs in shiitake cultivation. Heavily infection of the logs by *C. versicolor* easily wiped out the production of shiitake. Three isolates of *C. versicolor* were used to explore the nutritional requirements and environmental conditions for the mycelial growth and fruiting body formation of *C. versicolor*. Results of the PDA plate culture indicated that all three isolates grew very well between 28 and 32°C and 12 hours of alternating lights was better than continuous light or darkness. In stationary liquid culture, optimal pH value and C/N ratio were 6.0 and 80. Glucose and mannose were superior to the other carbon sources. Ammonium chloride was best among the nitrogen sources. Urea and sodium nitrite hampered the mycelial growth of *C. versicolor*. Medium amount in the culture container also affected its mycelial growth. In the 300ml flasks, best growth was found with 120ml of medium or 2.5/1 (v/v). Among the amino acids used in the mycelial growth tests, DL-asparatic acid was found best and DL-3 : 4-dihydroxy-phenyl-alanine was harmful. In sawdust cultures, best growth was recorded at the moisture content of 54%. Although the cultural filtrate of *C. versicolor* inhibited the mycelial growth of *C. versicolor* itself, agar medium containing 1000 or 2000ppm of the cultural filtrate of *C. versicolor* favored the mycelial growth of shiitake (*Lentinus edodes*). Formation of fruiting bodies of *C. versicolor* was observed 4 months after inoculation in the sawdust medium consisting of rice bran, wheat meal and calcium carbonate as it is used in shiitake cultivation.

Key words : Environmental Condition, *Coriolus versicolor*, Medical fungus.

Introduction

The wood decaying fungus *Coriolus versicolor* (Fr.) Quel, known as "Yuen-Zhi" (Japanese name "Kawaratake") were found in the decaying wood of apple, malpe and peach trees [1,10,14]. It also had been used in the isolation of anti-tumor substances [7,8,9

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,[15]. Logs used in the cultivation of shiitake were commonly infected by *C. versicolor* and *Stemonitis splendens*. Complete loss of shiitake may occur in the case of heavy infection[5,6]. This may due to the degradation of lignin by the fungus[3,12], thus the nutrients for *L. edodes* is limited. Provious studies indicated that it is a tetrapolor fungus in its mating type[11,14]. Two factors (A, B) were found in the control of its sexual cycle. It has been used as a medicine to cure many chronic diseases in chinese history and tradition and had been grown in the submerged cultures[2,4,13]. Information of this fungus in Taiwan is very limited. In this study , three isolates of *C. versicolor* were isolated from the logs in shiitake cultivation and used in the liquid culture and sawdust experiments. The main purpose was attemped to explore the nutritional requirements and environmental condition for the mycelial growth and fruiting body formation of *C. versicolor* which may be used in the development of control strategies in shiitake production or to develop a simulated medium and/or conditions for the growth or production of *C. versicolor* for medical uses.

Material and method

Isolation of the fungus : Isolates L-7501 and L-7502 were isolated from the logs of shiitake production in Puli in July and Sept. 1986, respectively. Isolate L-7601 was isolated from logs in Tuku in July 1987. They were grown on PDA at 28°C for mycelial growth and then maintained at 16°C for use.

Survey of *C. versicolor*-infection on the shiitake logs : Various kinds of logs two years after inoculation of *L. edodes* were surveyed. Infection or mycelial growth and fruiting body formation on each species of logs were observed by naked eyes and individually recorded. The percentage of infection and the kind of infected logs were summarized in Table 1.

Effect of temperature on the mycelial growth of *C. versicolor* : Agar discs (0.5cm) of the three isolates of *C. versicolor* were seperately transferred on the center of DPA plates. The plates were incubated at 16, 20, 24, 28, 32 and 36°C for 7 days without light and colony diameters for each isolate were recorded. Experiments were conducted three times with four replicates. Data were summarized in Table 2.

Effect of light on the mycelial growth of *C. versicolor* : Because 28°C was best in the previous test. Therefore 28°C was used in this experiments. PDA plates the same as decribed in temperature tests were incubated in the incubators with 12 hrs of alternating light or continuous light at 28°C, the plates wrapped with black cloth served as continuous dark. Colony diameters were recorded after 7 days. Results were shown in Table 3.

Nutrient requirement in submerged culture : One liter of distilled water containing glucose 30g, $(NH_4)_2HPO_4$ 5g, KH_2PO_4 1g, $MgSO_4$ 0.5g and yeast extract 0.1g, pH 6.0 was used as a basal medium. One each of the 22 carbon sources as listed in Table 4 was seperately added, 5% (w/v), into the basal medium for the comparison of their differences.

Experiments were conducted in 300ml flasks filled with 100ml of testing medium and inoculated with an agar disc (0.5cm) of *C. versicolor*. Under stationary condition, after they were incubated 28°C for 21 days, the mycelia were collected and dried at 60°C for 24hrs before weighting. Twelve nitrogen sources as listed in Table 5 at the concentration of 0.04% (w/v) each, 24 amino acid sources at the concentration of 0.04% (w/v) as listed in Table 6 were also conducted in the same procedures as carbon sources for the evaluation of their effect on the mycelial growth of *C. versicolor*.

For PH value studies, the Mcllavine buffer solution [2] was used in the adjustment of the initial PH value of the basal medium to 3, 4, 5, 6, 7, 8, 9 and 10. PH value were recorded again after sterilization. Agar disc (0.5cm) of different isolates of *C. versicolor* were inoculated. After they were incubated at 28°C for 21 days, the mycelial dry weight also were recorded as previously.

The effect of medium amount on the mycelial growth of *C. versicolor* was also conducted in the basal medium in 300ml flasks containing various amount of medium as listed in Table 8. Mycelial dry weight also was recorded after 21 days.

For C/N ratio studies, calcium nitrate and maltose were used to replace sodium nitrate and sucrose in the Czapek's solution medium and served as nitrogen and carbon sources, respectively. Various amount of C/N ratio as listed in Table 9 were tested and mycelial dry weight were recorded.

Effect of cultural filtrate of *C. versicolor* on the mycelial growth of *C. versicolor* itslef and *L. edodes*: Isolates of ***C. versicolor*** were incubated in the basal medium at 28°C for 21 days as previously described. The cultural filtrates, then, were collected and incorporated with PDA at the concentrations of 50, 100, 500, 1000 and 2000ppm. An inoculum agar disc (0.5 cm) of *C. versicolor* isolate L-7501 or *L. edodes* was inoculated onto the center of the plates. For *L. edodes* the inoculated plates were incubated at 24°C and *C. versicolor* L-7501 at 28°C. The colony diameter were recorded after 14 days.

Effect of water content of sawdust medium on the mycelial growth of *C. versicolor* : Calcium carbonate was used to adjust the PH value of sawdust medium (sawdust 400g, rice bran 60g, and wheat meal 40g) to 6.0. The medium was adjusted to vario us water contents as listed in Table 12. They were then evenly filled into the glass tubes (22/3cm, length/diameter) as uniformly as purpose. After sterilization at 121°C, 15 lb/in^2, for 30 minutes, the tubes were inoculated at the both ends with various isolates of *C. versicolor*. The growth rates were recorded after 14 days at 28°C.

Cultivation trial of *C. versicolor* : Because *C. versicolor* and *L. edodes* are commonly grown on the same logs, the same sawdust medium (water content 55%) as in the previous test was used. This medium is also commonly used in the shiitake cultivation. The medium was filled into the PP-plastic bags and/or glass bottle. They were then sterilized at the conditions as listed in Table 13. After the inoculation of *C. versicolor* (isolate L-7502), the growing condition or management was the same as growing shiitake. Days for fruiting and dry weight of fruiting bodies for each treatment were recorded.

Results

Infection of *C. versicolor* on the logs of shiitake cultivation

As shown in Table 1, infection or contamination of *C. versicolor* was common on the various kind of logs in shiitake cultivation. The highest percentage, i. e., 18% and 13% of infection were observed on the shiitake log of *Liquidambar formosana* at Puli and Tuku, respectively.

Table 1. Infection of *C. versicolor* on the logs of shiitake two years after inoculation of *L. edodes*

Scientific name of log	Infection percentage (%) of logs by *C. versicolor* at	
	Puli	Tuku
Liquidambar formosana	18*	16
Castanopsis hystrix	10	9
Quercus variabilis	8	8
Cyclobalanopsis glauca	6	7
Engelhardtia roxburghiana	5	5
Elaeocarpus sylvestris	3	4
Alnus formosana	2	2
Acacia confusa	2	1

* : Data were mean of 200 logs of each kind of tree.

Effect of temperature on the growth of *C. versicolor*

As shown in Table 2, mycelial growth was observed between 16°C and 32°C. No growth was observed at 36°C. The optimal temperatures were between 28 and 32°C.

Table 2. Colony diameter (cm) of *C. versicolor* isolates grown on PDA plates at various temperatures for 7 days

Temp. (°C)	Isolate of *C. versicolor*		
	L-7501	L-7502	L-7601
16	3.4*	3.6	3.3
20	7.2	7.4	7.0
24	7.4	7.6	7.2
28	8.0	8.0	7.9
32	8.0	8.0	8.0
36	0**	0	0

*. Data were based on the mean of four plates of PDA medium.
** : O: no visible growth was observed.

Effect of light on the mycelial growth of *C. versicolor*

As shown in Table 3, light is necessary in the formation of fruiting body primodia. For the mycelial growth 12-hrs of alternating light require was superior to the others.

Table 3. Colony diameter (cm) of *C. versicolor* isolates grown on PDA plates at various light conditions at 28°C for 7 days

Treatment	Colony diam. (cm) of *C. versicolor* isolate			Mycelial density
	L—7501	L—7502	L—7601	
continuous light	7.7*	7.6	7.8	primodium formed
12 hrs alternating light	8.0	8.0	8.0	compact
continuous darkness	7.6	7.5	7.6	loose

* : Data were based on the mean of four PDA plates in each treatment.

Table 4. Effect of carbon sources on the mycelial growth of *C. versicolor*

Carbon source*	Mycelial dry weight (mg) of *C. versicolor* isolate		
	L-7501	L-7502	L-7601
Arabinose	0 h	0*** i	0 i****
Cellobiose	288** c	296 c	294 c
Cellulose	104 f	109 f	112 f
Dextrin	110 ef	114 ef	108 f
Fructose	516 a	514 a	508 a
Galactose	212 c	236 c	225 c
Glucose	631 a	628 a	634 a
Glycerol	0 h	0 i	0 i
Inositol	0 h	0 i	0 i
Inulin	134 e	138 e	142 e
Lactose	174 d	178 d	182 d
Maltose	508 a	502 a	511 a
Mannitol	68 g	72 g	66 g
Mannose	624 a	628 a	634 a
Raffinose	172 d	170 d	168 d
Rhamnose	124 e	128 e	116 f
Ribose	0 h	0 i	0 i
Sorbitol	196 d	189 d	202 c
Starch	316 bc	324 b	332 b
Sucrose	96 f	89 f	86 g
Trehalose	56 g	55 h	48 h
Xylose	386 b	389 b	375 b
Control	0 h	0 i	0 i

*. Concentrtion of each carbon source was 5% (w/v) in the basal medium.

**. Mycelial dry weight (mg) of *C. versicolor* isolates after they were incubated at 28°C for 21 days in 300ml flasks containing 100ml of testing medium with 4 replicates.

***. No mycelial growth was observed.

****. Means with the same letter across carbon sources are not significantly different at 5% level by Duncan's Multiple Range Test.

Nutrient requirements in submerged culture

Carbon source. All three isolates of *C. versicolor* could grown in many carbon sources. Maximum mycelial growth was observed in glucose and mannose. No growth was observed in arabinose, glycerol, inositol, ribose and control (basal medium without adding carbon source) (Table 4).

Nitrogen source. Of the 12 nitrogen sources tested, maximum mycelial growth was observed in ammonium chloride, no mycelial growth was observed in urea and sodium nitrite. Good growth was also observed on calcium nitrate and other nitrogen sources. (Table 5)

Table 5. Effect of nitrogen sources on the mycelial growth of *C. versicolor*

Nitrogen source*	Mycelial dry weight (mg) of *C. versicolor* isolate		
	L-7501	L-7502	L-7601
Ammonium acetate	450** a	489 a****	446 b
Ammonium chloride	576 a	614 a	570 a
Ammonium citrate	467 b	478 ab	453 b
Ammonium nitrate	435 b	461 b	428 b
Ammonium phosphate, monobasic	507 a	502 a	483 a
Ammonium sulphate	489 ab	500 a	482 a
Calcium nitrate	566 a	580 a	562 a
Casamino acid	526 a	531 a	539 a
Potassium nitrate	501 a	486 a	477 ab
Sodium nitrate	485 ab	481 ab	470 ab
Sodium nitrite	0***c	0 c	0 c
Urea	0 c	0 c	0 c
Control	475 ab	483 a	469 ab

*. Concentration of each nitrogen source was 0.04% (w/v) in the basal medium.

**. Mycelial dry weight (mg) of *C. versicolor* isolates after they were incubated at 28°C for 21 days in 300ml flasks containinng 100ml of testing medium with 4 replicates.

***. No mycelial growth was oberved.

****. Means with the same letter across nitrogen sources are not significantly different at 5% level by Duncan's Multiple Range Test.

Amino acids. Among the 24 amino acids tested, mycelial growth of C. versicolor was found in the media containing DL-asparatic acid and L-tyrosine, others were found deteriorating to its growth, and no growth observed in the medium containing DL-3:4-dihydroxy-phenyl-alanine (Table 6).

Table 6. Effect of amino acids on the mycelial growth of *C. versicolor*

Amino acid*	Mycelial dry weight (mg) of *C. versicolor* isolate		
	L-7501	L-7502	L-7602
DL-α-alanine	398** c	406 c	411 c****
DL-2-amino-n-butyric acid	569 a	554 a	548 a
L-arginine monohydrochloride	543 a	540 a	542 a
DL-asparatic acid	625 a	614 a	632 a
L-cystine	535 a	532 a	528 a
L-cystine hydrochloride	576 a	558 a	554 a
DL-3 : 4-dihydroxy-phenyl-alanine	0*** e	0 e	0 e
L-glutamic acid	395 c	502 c	416 c
Glycine	537 a	544 a	532 a
L-histidine monohydrochloride	282 d	297 d	278 d
L-hydroxy-proline	580 a	594 a	572 a
DL-iso-leucine	454 b	488 b	476 b
L-leucine	495 b	506 b	516 b
L-lycine monohydrochloride	433 b c	445 b	452 b
DL-methionine	394	398 c	402 c
DL-ornithine monohydrochloride	427 b c	425 b c	438 b c
DL-β-phenyl-alanine	414 c	423 b c	426 b c
L-proline	552 a	546 a	537 a
DL-serine	525 a b	514 a	526 a
DL-nor-leucine	507 b	511 b	518 b
DL-threonine	556 a	552 a	541 a
DL-trytophan	572 a	558 a	563 a
L-tyrosine	604 a	612 a	608 a
DL-valine	582 a	574 a	556 a
Control	602 a	611 a	604 a

*. Concentration of each amino acid was 0.04% (w/v) in the basal medium.

**. Mycelial dry weight (mg) of *C. versicolor* isolates after they were inclubated at 28°C for 21 days in 300ml flasks containing 100ml of testing medium with 4 replicates.

***. No mycelial growth was observed.

****. Means with the same letter across amino acids are not significantly different at 5 % by Duncan's Multiple Range Test.

PH value. The PH values of the medium were always decreased after sterilization. Although good growth was observed in the PH value from 2.8 to 9.7 after sterilization, maximum growth was found roughly between PH 5 and 6 (Table 7).

Table 7. Effect of pH values on the mycelial growth of *C. versicolor*

Initial pH	Final pH after sterilization	Mycelial dry weight (mg) of *C. versicolor* isolate		
		L-7501	L-7502	L-7601
3.0	2.8	458* c **	481 d	498 c
4.0	3.7	638 b	662 b	642 a
5.0	4.7	732 a	744 a	648 a
6.0	5.7	748 a	772 a	660 a
7.0	6.7	652 b	678 b	654 a
8.0	7.7	636 b	651 b c	618 b
9.0	8.8	627 b	624 c	604 b
10.0	9.7	614 b	603 c	598 b

*. Mycelial dry weight (mg) of *C. versicolor* isolates after they were incubated at 28°C for 21 days in 300ml flasks containing 100 ml of testing medium with 4 replicates.

**. Means with the same letter across initial pH are not significantly different at 5% level by Duncan's Multiple Range Test.

Table 8. Effect of medium amount on the mycelial growth of *C. versicolor*

Amount of medium in a 300ml flask	Mycelial dry weight (mg) of *C. versicolor* isolate		
	L-7501	L-7502	L-7601
20 ml	164* f **	202 e	173 f
40	284 e	278 e	189 e
60	513 c	519 c	515 c
80	528 c	538 c	533 c
100	698 b	708 b	678 b
120	918 a	903 a	907 a
140	785 b	776 b	780 b
160	714 b	706 b	723 b
180	504 c	503 d	494 c
200	416 d	426 c	429 d

*. Mycelial dry weight (mg) of *C. versicolor* isolates after they were incubated at 28°C for 21 days in 300ml flasks with 4 replicates.

**. Means with the same letter across amount of media are not significantly different at 5% level by Duncan's Multiple Rang Test.

Amount of medium. The best mycelial growth of *C. versicolor* was found in 300ml flasks filled with 120ml of medium. More or less than 120ml, the amount of mycelial growth was reduced (Table 8).

C/N ratio. Maximum mycelial growth was observed in the medium with C/N ratio at 80, mycelial growth decreased when the C/N ratio was higher or lower than 80 (Table 9).

Table 9. Effect of C/N ratio of medium on the mycelial growth of *C. versicolor*

C/N ratio*	Mycelial dry weight (mg) of *C. versicolor* isolate		
	L-7501	L-7502	L-7601
10	41** f	82 f	59 f***
20	151 e	106 f	126 e
30	178 d	138 e	164 d
40	238 c	224 d	199 d
50	270 c	262 c	245 c
60	296 b c	285 c	281 c
70	346 b	379 b	358 b
80	517 a	583 a	532 a
90	316 b	373 b	392 b
100	214 d	246 c d	166 d

*. Maltose and calcium nitrate were used as carbon and nitrogen source, respectively, to replace sucrose and sodium nitrate in the Czapek's solution medium.

**. Mycelial dry weight (mg) of isolates of *C. versicolor* grown at 28°C for 21 days in 300ml flasks containing 120ml of different C/N ratio medium, and data were based on the mean of four flasks.

***. Means with the same letter across C/N ratios are not significantly different at 5% level by Duncan's Multiple Range Test.

Table 10. Effect of cultural filtrates of isolates of *C. versicolor* on the mycelial growth of *C. versicolor* isolate L-7501

Cultural filtrate concentration (ppm)	Colony diam. (cm) of *C. versicolor* L-7501 isolate grown in the cultural filtrate of *C. versicolor* isolate		
	L-7501	L-7502	L-7601
50	7.9* a	7.8 a	7.8 a**
100	7.8 a	7.7 a	7.7 a
500	7.5 a	7.4 a	7.5 a
1,000	7.4 a	7.3 a	7.3 a
2,000	5.9 b	6.0 b	6.0 b
Control	8.0 a	8.0 a	8.0 a

*. Colony diameter (cm) of *C. versicolor* isolate L-7501 were based on the mean of four plates at 28°C for 14 days on PDA medium containing various amount of cultrate of *C. versicolor* which was grown in the basal medium for 21 days at 28°C.

**. Means with the same letter across concentrations are not significantly different at 5% level by Duncan's Multiple Range Test.

Effect of cultural filtrate of *C. versicolor* on the mycelial growth of *C. versicolor* itself and *L. edodes*

When the cultural filtrate of *C. versicolor* was incorporated with the medium to grow *C. versicolor*, the growth was inhibited even the concentration was as only 50ppm, and the inhibition increased with the increase of cultural filtrate concentration (Table 10). However, the cultural filtrate of *C. versicolor* increased the growth of *L. edodes* (Table 11, Fig. 1).

Table 11. Effect of cultural filtrates of isolate of *C. versicolor* on the mycelial growth of *L. edodes*

Cultural filtrate concentration (ppm)	Colony diam. (cm) of *L. edodes* grown in the cultural filtrate of *C. versicolor* isolate of		
	L-7501	L-7502	L-7601
50	5.6* c	5.7 c	5.7 c**
100	5.9 b	6.0 b	5.9 b
500	6.0 b	6.0 b	6.0 b
1000	6.6 a	6.5 a	6.5 a
2000	6.9 a	6.8 a	6.8 a
Control	5.5 c	5.4 c	5.4 c

* : Colony diameter (cm) of *L. edodes* were based on the mean of four plates at 24°C for 14 days on PDA medium containing various amount of cultural filtrate of *C. versicolor* which was grown in the basal medium for 21 days at 28°C.

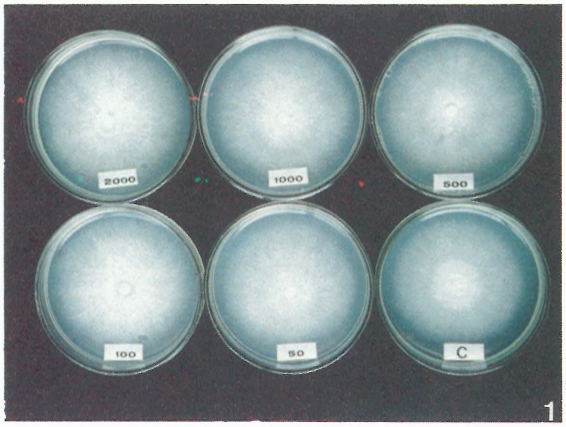
**. Means with the same letter across concentrations are not significantly different at 5% level by Duncan's Multiple Range Test.

Table 12. Effect of water content of sawdus medium on the mycelial growth of *C. versicolor*

Water content (%) of sawdust medium	Mycelium growth rate (cm/14 days at 28°C) of *C. versicolor* isolate		
	L-7501	L-7502	L-7601
52	18.2* a	18.0 a	17.8 a**
54	19.0 a	19.0 a	19.0 a
59	17.6 a	17.7 a	17.5 a
60	17.4 a	17.4 a	17.5 a
61	17.4 a	17.4 a	17.4 a
62	17.2 a	17.4 a	17.2 a
64	16.4 a b	16.6 a b	16.5 a b
65	15.2 b	15.4 b	15.0 b
66	14.0 b	14.2 b	14.0 b
68	14.0 b	14.1 b	13.8 b
70	11.3 c	10.8 c	11.6 c

*. Data were based on the mean of two observations of mycelial length on both sides of the tubes, and four tubes were conducted for each treatment.

**. Means with the same letter across water contents are not significantly different at 5% level by Duncan's Multiple Range Test.


2000
1000
500
100
50
C
1

Coriolus versicolor
2

L-7501

L-7601

L-7502
3

Effect of water content of sawdust medium on the mycelial growth of *C. versicolor*

Optimal mycelial growth was observed in the sawdust medium containing 54% of moisture (Table 12, Fig. 2). It seems that the moisture between 50 and 60% were all suitable. If the moisture higher than 70%, the mycelial growth was greatly inhibited.

Cultivation trial of *C. versicolor*

Fruiting body formation was observed in all three type of vessels, 120 to 140 days after inoculation depending upon the vessel type. Highest yield of fruiting body was observed in 1000ml-glass bottles, followed by 2000ml-plastic bags and 500ml- glass bottles (Table 13).

Table 13. Cultivation trials of isolate L-7502 in different vessels

Item	Vessel and capacity		
	plastic bag (2000 ml)	glass bottle (500 ml)	glass bottle (1000 ml)
condition of sterilization	98°C for 4 hrs.	121°C, 15 lb/in² for 60 min.	121°C, 15 lb/in² for 90 min.
wt. of medium	1,000g	400g	800g
dry wt. (g) of fruiting bodies*	21.3(b)**	18.4(c)	32.8(a)
days for fruiting	140	120	130

*. The dry weights were based on the mean of 20 bags or bottles.

**. Means with the same letter across dry wt. of fruiting bodies are not significantly different at 5% level by Duncan's Multiple Range Test.

Discussion

Among the shiitake logs tested, maple tree (*Liquidambar formosana*) was the one that is most easily infected by *C. versicolor* (Table 1). Although *Stemonitis splendens* is also commonly observed in the shiitake logs, it is more easily found on the logs of *Engelhardtia roxburghiana* [6]. Results indicated that the basal medium used in this study is suitable for the growth of *C. versicolor*. Similar results were also obtained by Darbyshire et al [1]. Fruiting body primodia of *C. versicolor* were observed in the cultures exposed to the continuous light (Table 3). It seems that light is necessary in the process of fruiting body formation.

Factors such as temperature, PH value, amount of medium in a 300ml flask, C/N ratio of medium, carbon source, nitrogen source, and amino acid may greatly affect the mycelial growth of *C. versicolor*. Results of this study indicated that the optimal temperature was 28°C (Table 2), the best carbon sources were glucose and mannose (Table 4), the best nitrogen sources were ammonium chloride and calcium nitrate (Table 5), the best amino acid was DL-asparatic acid (Table 6) which is very similar

to that for *L. edodes*[13], the optimal PH values for mycelial growth was between 5 and 6 (Table 7).

The appropriate amount of medium in 300ml flask was 120ml (Table 8). All the results decribed above were very similar to that of *L. edodes* reported by the previous authors[5,13]. The best C/N ratio of medium for the growth of *C. versicolor* was about 80 (Table 9). However, *Lepiota naucina*, *Agaricus bisporus*, and *Volvariella volvacea* were reported at 25, 30, or 60[5,13]. It means that different fungi need different C/N ratio for their growth.

Cultural filtrate of *C. versicolor* did not inhibited the growth of *L. edodes*. The incorporated cultural filtrates may provide extra nutrients, therefore, the colony diameter of *L. edodes* increased with concentration of the cultural filtrate incorporated (Table 11). It seems that the growth of shiitake inhibited by *C. versicolor* on the logs was due to the vigorous growth of *C. versicolor* which resulted in the comsumption of nutrients or the competition of growing space. Water content of sawdust did affect the growth of *C. versicolor*. Although 54% was the best, moisture between 50 and 60, in general, were all suitable (Table 12), and it was very similar to the conditions of other wood decaying fungi. *C. versicolor* produced fruiting bodies in all three type of vessels tested (Fig. 3). However, days from inoculation to fruiting body formation varied. The smaller the vessels, the lesser the days needed for fruiting (Table 13). It may due to the nutrient in the smaller vessels became a limiting factor, which induced fruiting body formation was sooner than the larger vessel, *C. versicolor* and other wood decaying fungi such as *Ganoderma lucidum* and *G. applanatum* are commonly used as medicine to control many human diseases. However, information of cultivation was limited. This study may provide as a basis to explor their mysterious in nature. Obviously, further research is needed.

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一種木材腐朽菌及藥用真菌—雲芝，其生長之營養及環境條件之探討[1]

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摘 要

雲芝 (*Coriolus versicolor*) 是一種香菇段木栽培時常見的害菌，但自古以來它也是用作防治慢性病的眞菌。一旦受其感染，則該段木幾無收成可言。三個雲芝菌株在 PDA plate 上培養結果顯示，最適溫度爲 28—32°C，且在12小時光照，12小時黑暗時，菌絲生長最好。故在探討營養要求方面之液體培養試驗時均在 28°C 下，靜置培養21天，培養結果顯示 Glucose 及 Mannose 爲最佳碳源，Ammonium chloride 爲最佳氮源，但 Urea 及 Sodium nitrite 反不利 *C. versicolor* 菌絲之生長。在所有供試之氨基酸中，DL-asparatic acid 有利雲芝菌絲生長，DL-3 : 4-dihydroxyphenyl-alanine 則不利。而在 pH 值爲6.0及C/N ratio 爲80時菌絲生長最好。培養液容量也會影響菌絲生長，在 300ml 的三角瓶中，若含 120ml 的培養液，則可得到最多之菌絲乾量。而木屑培養時最適當之含水量爲 54%。本菌其培養液會影響其自身之生長，但是若以 1,000ppm 或 2,000ppm 之量混合在固體培養基中，反有利香菇菌絲之生長。本試驗之三個菌株都可在栽培香菇用之木屑培養基中產生子實體，培養期約四個月。木屑培養基中含有米糠；麥粉及碳酸鈣等添加物。

關鍵詞：環境條件、雲芝、藥用眞菌。

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